APPENDIX E3

SAMPLING PLAN FOR MONITORING CROSS-HUDSON PIPELAYING OPERATIONS

ATTACHMENT M

SAMPLING PLAN FOR MONITORING CROSS-HUDSON PIPELAYING OPERATIONS

SAMPLING PLAN for MONITORING CROSS-HUDSON PIPELAYING OPERATIONS

OBJECTIVE

The objective of this sampling plan is to monitor water quality and sedimentation during the Haverstraw Bay dredging and pipelaying operations and verify that the affects predicted by the water quality and sedimentation modeling are not exceeded.

SUMMARY

Water quality will be monitored at multiple upstream and downstream locations during both dredging and backfilling operations. Monitoring will be more intense during initial operations until sufficient data are collected to verify that the affects on water quality are within the limits predicted by the model results. Water quality monitoring will continue at reduced intensity for the duration of the pipelaying operation to assure that water quality affects are minimized. Bottom profiles will also be measured before and after pipelaying to assess changes in sediment levels in the dredge area and adjacent areas. Monitoring results will be reported weekly and operations will be adjusted, if necessary, based on results.

PARAMETERS

The following water quality parameters will be measured:

- total suspended solids (TSS) as mg/l
- settleable solids (SS) as mg/l
- turbidity as NTU

The following sample identification data will be recorded:

- station identifier (see table below)
- vessel location (as lat/lon or state plane)
- date and time (prevailing zone time) of sample (as date, hour, minute)
- depth of sample (as near-surface, mid-depth or near-bottom)
- total water depth (as ft)

In addition, for each series of stations occupied, the following observations will be recorded at the commencement and during the run:

dredge location at start (as lat/lon or state plane)
dredging/pipe laying/backfilling operations underway at start
weather conditions at start (qualitative)
tidal current phase at start (flood or ebb)
sea conditions (qualitative)

passage of large vessels and barge tows (plus recreational vessels in shallower water) that may influence the turbidity of the waters
dredge location at end (as lat/lon or state plane)
changes in dredging/pipelaying/backfilling operations during transect
tidal current phase at end (flood or ebb)

METHODS

TSS and SS will be determined by laboratory analysis of water samples in accordance with New York State mandated procedures. All reasonable, professional efforts will be made to complete the analyses within 24 hours of receipt of samples.

Turbidity will be determined using a field nephelometer (turbidimeter), calibrated in accordance with the manufacturers requirements.

Total water depth at each station will be determined using a navigational acoustic depth sounder

Depth of water quality sample will be determined by length of cable deployed and cable angle

Time of sample will be determined using an accurate quartz timepiece, calibrated to the National Institute of Science and Technology (NIST) master clock signal available over the internet

Station location will be determined using Differential GPS, based on U.S. Coast Guard broadcast real- time differential corrections for the region

Bathymetric profiles will be measured with a recording acoustic depth sounder and location will be determined by DGPS.

MONITORING SCHEDULE

Pre-Operation

Prior to active dredging, pipelaying and backfilling operations, bathymetric profiles will be measured at perpendicular transects along the proposed pipe route as described below.

Initial Operations Period

Daily sampling will be conducted during the first two weeks of operations to establish the success of the environmental controls on dredging and backfilling operations, and to provide data for adjustment of the sampling program. During each day of water quality sampling, a minimum of four longitudinal transects will be monitored. When shallow water backfilling or deep-water barge dumping operations are to be conducted, at least one additional transect will be monitored. Each transect will consist of six stations. Assuming dredging operations will take place for approximately 10 hours each day, the transects will be monitored at approximately 2, 4, 6 and 8 hours after commencement of daily operations. Monitoring will begin while dredging or backfilling operations are underway and will continue until complete, regardless of any changes in operations following the start of the transect, such as a pause in active dredging or shift to backfilling. Survey personnel will coordinate with the dredging contractor to determine anticipated daily work schedule, so that there will be a maximum likelihood that transects will be completed during active dredging or backfilling.

On-going Operational Period

Subject to any adjustments resulting from analysis of data from the Initial Period, conducting sampling during the period following initial operations will be reduced to three days each week to monitor continued success of the environmental controls. During each day of operational period sampling, two longitudinal transects will be monitored. When deep-water barge dumping operations are to be conducted, one of the transects will be timed to coincide with those operations and one to coincide with dredging. Each transect will consist of six stations. The actual timing of those transects will depend on the daily work schedule. Each transect will begin while dredging or backfilling operations are underway and will continue until complete, regardless of any changes in operations following the start of the transect, such as a pause in active dredging. Survey personnel will coordinate with the dredging contractor to determine anticipated daily work schedule, so that there will be a maximum likelihood that transects will be completed during active dredging or backfilling. Also during the Operational Period, we will conduct bathymetric surveying in the areas previously backfilled, as discussed below.

BATHYMETRIC TRANSECTS

The intent of the surveying will be to confirm that the post-backfill bottom contours are approximately the same as those pre-dredging. Bathymetric profiles will be recorded on transects normal to the pipeline route at 500 ft intervals along the route. Each transect will begin approximately 1000 ft up river from the intended trench centerline and will continue 1000 ft down river from the centerline. Pre-operational transects will be performed during the week prior to commencement of dredging. Operational period transects will be conducted 1 week to 10 days after backfilling is completed at the site of a given transect. Differential GPS will be used to position the Operational period transects to coincide with the Pre-operational transects (within small boat navigational accuracy). A water level gage will be installed in the vicinity of each end of the pipeline crossing to provide water surface reference. The water level gages will be surveyed into a common vertical datum. Raw sounder results will be recorded and subsequently adjusted for concurrent water surface elevation. The adjusted soundings will be plotted as water depth relative to MLLW versus distance along transect. The trench centerline will be indicated on each transect plot.

LONGITUDINAL TRANSECTS

Each water quality transect will consist of six stations. The stations will be located relative to the position of the dredge or barge at the beginning of the transect (regardless of any subsequent changes in location). The stations will be at

Station Identifier	Range to Dredge or Barge
U1	1000 ft up current
U2	500 ft up current
D1	100 ft down current
D2	500 ft down current
D3	1000 ft down current
D4	5000 ft down current

The stations will be occupied sequentially from farthest up current to farthest down current. If the transect will take place during a time near slack water, the direction of the transect will correspond to the previous current phase. Each station will be located such that it is at the specified straight-line range and in approximately the same total depth of water as the dredging operations taking place.

Shallow-water dredging and backfilling will be done sequentially, so the stations will be relative to whatever operation is taking place at a given time. Deep-water dredging and backfilling will be done concurrently, but backfilling is expected to take place approximately twice daily, in contrast to continuous dredging operations. When backfilling takes place, Stations D1 through D4 will be doubled, so that there will be a station at each range down current of the dredge and down current of the dump barge. These doubled stations will be identified with a "d" or a "f" suffix for "dredge" and "fill", respectively (e.g., D2f would be a station 500 ft down current from a dump barge over the same depth contour).

At each station, a 2 liter water sample will be taken using a Niskin bottle or a pumped sample, and a turbidity observation will be made using a field nephelometer (turbidimeter) at each of the following depths:

- 2 ft below the surface
- mid-depth
- 3 ft above the bottom

The water samples will be handled in accordance with New York State standards for analysis of TSS and SS.

EVALUATION AND REPORT

Raw turbidity data will be available in real time and reported at the end of each day of monitoring. Raw TSS and SS data will be available within 36 hours of sample collection (24 hours of arrival at the laboratory).

On completion of each week of monitoring, a brief letter report will be prepared in electronic format summarizing the monitoring results. The resulting water quality and location data will be tabulated and plotted as appropriate for comparison with the water quality conditions forecast by the model

JUSTIFICATION OF PROPOSED SAMPLING PLAN

STATION LOCATIONS

Range from Dredge

In their 05 November 1999 email, DEC provides the following suggested spacing of the stations:

> Two sites upstream of the active dredge area, one site very near active dredge location (100 ft. dnstrm), one site just downstream visible plume (i.e., 35 ft. in shallow water, 460 ft. in deep water), one site each at locations several hundred and several thousand feet downstream of active dredge site.

We take the terms "shallow water" and "deep water" to mean "6 cu. yd. bucket operations" and "22 cu. yd. bucket operations", respectively. We also assume that "upstream" and "downstream" mean "up current" and "down current", respectively, regardless of whether that is up river or down river, because the currents in this stretch of the Hudson are tidally reversing under all but the most unusual circumstances.

The actual distances specified in the table are rounded to the nearest 100 ft for ease of location under normal field operating conditions.

Stations U1 and U2 correspond to the two suggested upstream sites, and stations D3 and D4 correspond to the suggested sites "...several hundred and several thousand feet downstream...." Station D1 is the site 100 ft downstream; it also satisfies the requirement for a close-in "shallow water" station.

At 100 ft, Station D1 would be slightly less than 35 ft down current from the down current limit of the open trench. The trench will be approximately 150 ft. wide, or 75 ft. half-width on centerline, and the dredge barge will occupy a large part of that width. A station at 35 ft. from the trench centerline would lie within the immediate zone of dredging operations. LMS does not believe that samples taken within the immediate dredging zone will be representative of the conditions intended to be protected by the dredging plan, nor would they be representative of the condition modeled. While the Kuo and Hayes model treats the dredge as if it were a steady-state point source, the physical reality is that the dredging occupies a finite space and that each sequential bucket will come from a slightly different location both laterally and longitudinally in the river. We believe station D1 satisfies the intent of the close-in shallow water station, as well as corresponding to the 100 ft station in the deep water case.

Station D2 corresponds approximately to the suggested 460 ft deep water station, and will provide an intermediate station between 100 ft and 1000 ft for the shallow water case.

ATTACHMENT N
RESPONSE TO FERC OCTOBER 5, 1998 DATA REQUEST NO. 88
FILED ON OCTOBER 20, 1998

This attachment was previously filed with FERC and not included in this package

Total Depth of Water

We have specified that each station will be at the indicated range from the barge and in the same total depth of water as the dredging operations. We expect that currents will tend to follow the bathymetric contours of the bottom in this part of the river, so this procedure will place each station approximately on the centerline of the plume. In addition, this procedure will eliminate difficulties interpreting the data resulting from changes in depth and settling of sediment on the bottom.

DEPTH OF SAMPLING

In their 05 November 1999 email, DEC suggested samples be collected "...at top (1 ft. below surface), middle, and bottom (within s ft. of water column)...." As a practical matter, it is difficult under most field conditions to assure that a sample is within 1 ft. of the surface; wind waves on the Hudson can be 1 ft. under typical conditions. Accordingly, we have expanded the definition of "surface" to be within the upper 2 ft. of the water column. Similarly, near bottom waters in Haverstraw Bay are known to have highly variable turbidity under natural conditions. In addition, any attempt to position a sampling bottle within 2 ft. of the bottom runs the risk of disturbing the existing natural sediments, creating any artificially high reading. As a result, we propose to obtain the near-bottom sample at approximately 3 ft. off the bottom, to assure an observation that is more representative of the water column.

USE OF MONITORING OBSERVATIONS IN REAL-TIME

The only direct observation of water quality that will be available in real-time is turbidity, which will be measured using a field nephelometer (turbidimeter). At the low TSS concentrations adopted to define the visible edge of the dredge plume, there is no good correlation between TSS and turbidity. In addition, a review of available concurrent observations of natural TSS and turbidity in this reach of the Hudson River suggests that natural variability may be greater than the threshold adopted as the limit of the plume. Therefore, it is not be possible to measure the extent of the plume in real-time using the turbidity readings, and any attempt to control the dredging operations using the available observations in real time will be complicated by natural variations. Changes may be indicated by analyses of complete data sets from several days of monitoring where affects of the operations can be better differentiated from natural variations. Should analysis indicate that conditions exceed predicted effects, dredging and/or backfilling operations will be altered to reduce water quality impacts. Specific operating parameters such as bucket rate, tidal conditions and/or the use of silt curtains will be considered to mitigate impacts. The intense monitoring frequencies will be continued to evaluate the effectiveness of such operational changes.

DEPOSITION OF SEDIMENTS

LMS believes that there is no practical direct method to confirm the average sediment deposition thicknesses forecast by the Kuo and Hayes model in the context of the proposed pipelaying operation, but these estimates can be confirmed indirectly.

Repeated qualitative observations by experienced LMS personnel of actual conditions on the bottom of Haverstraw Bay suggest that the there is substantial movement of a relatively fluid near-bottom layer of natural sediments in the Bay, and that the movement is highly variable in space and time. Under these conditions, use of sediment traps to estimate additional deposition resulting from the pipelaying operation would be complicated by the inability to statistically differentiate the results of the dredging process from the highly variable natural processes.

In addition, those same qualitative observations suggest that any attempt to measure sediment deposition by such means as calibrated stakes or video taping will be frustrated by the extremely low visibility in the near bottom waters of the Bay accompanying this natural movement. The low visibility is the result of relatively high turbidity in near bottom waters associated with tidal currents, and the location of the salt front.

However, we note that confirmation of the model estimated TSS concentrations in the water column necessarily implies that the corresponding bottom deposition estimates are also reliable. The anticipated average sediment deposition thicknesses presented in the answer to DEC Data Request No. 8 are based on the results of the Kuo and Hayes model. The Kuo and Hayes dredging model assumes that the TSS concentration at a given point is controlled by two mechanisms: settling to the bottom and cross-current turbulent diffusion. In effect, the model partitions the solids load between a suspended fraction and a settled fraction. By mass-balance, if the waterborne concentrations are correct, then the fraction settled to the bottom must be correct. (Note: the Kuo and Hayes model is a vertically averaged model.)

Thus, if the water column monitoring program confirms the model results for the waterborne concentration of TSS, then the forecast average bottom deposition thicknesses must also be correct.

With these understandings, we see no basis to attempt a direct deposition measurement program when the water column monitoring can reasonably be interpreted as confirmation of the modeled sedimentation.

DURATION OF MONITORING PROGRAM

We believe that an Initial Period of two weeks including both types of dredging (small bucket and large bucket) and backfilling will be sufficient to assess impacts and confirm the model results and allow a judgement regarding reduction of monitoring intensity. During this period, we will have occupied each of the six stations 40 times (assuming a 5-day operating week), collecting and analyzing 1200 samples for each of the three parameters (TSS, SS and turbidity). The Kuo and Hayes model is a vertically averaged model, so the three individual samples taken each time a station is occupied (near surface, mid-depth and near-bottom) would be averaged to create a single value for each time a station was occupied, producing 72 data points with which to compare this steady-state model. If the model results are confirmed with those first two weeks of data, there is no reason to believe that there would be substantial variation during the remaining period of dredge operations

Under these circumstances the results of the model can be relied upon as a reasonable estimate of the results of pipelaying operations in Haverstraw Bay. In addition, as noted above, the real-time monitoring results cannot be effectively used to control the dredge operations.

Thus, we propose to reduce the field monitoring program once both the shallow water and deep water dredging model results have been confirmed. As stated above, we believe two weeks of data will be sufficient to provide that confirmation.

TIMING OF BARGE DUMP OPERATIONS

Attempting to constrain the barge dump operations to coincide with slack water is both impractical and not likely to achieve the desired result. It is our understanding that the proposal to require slack water dumping is motivated by a desire to minimize the area affected by the dump operations. Slack water is a nearly instantaneous event and the duration of the lowest 10th percentile currents (less than 0.07 m/s in the vicinity of Bowline Generating Station) is very brief in the Hudson River, typically on the order of 15 minutes. (See our letter report in the soon-to-be-released Hudson River DEIS for the Hudson River Utilities (Appendix VI-3-B, expected 15 December 1999), in which we evaluate 10th percentile currents in the River.) In addition, meteorological and hydrological conditions can cause substantial deviations from the forecast time of occurrence. These factors combined with operational constraints associated with tug and barge movement and positioning make it highly unlikely that dumps could be effectively coordinated with slack water.

Even if that could be accomplished, a barge dump is not an instantaneous event and a significant fraction of the resulting suspended solids can be expected to still be present in the water column when currents increase. The mechanics of a barge dump in these depths is that the vast majority of the dump material will land directly under the barge, with a smaller fraction going into suspension in the water column. The result will be that those suspended solids will settle outside the immediate zone of the trench, as they are transported by the tidal currents. The suspended material will settle as the plume travels with the currents. The volume of water affected by the dump operation will not change significantly with tidal current, the affected volume will travel with the current and settlement will remove suspended material at the same time rate. The zone of deposition will change with tidal current. Based on this analysis, there does not appear to be any clear environmental advantage to restricting backfilling operations to slack tide periods.

BARGE DEWATERING

It is our understanding in preparing this sampling plan that

- no barge overflow will be permitted
- shallow-water backfilling will be accomplished using the same 6 cu.yd environmental bucket used to dredge those materials

DEC will permit discharge of supernatant water remaining in the barges after shallow-water backfilling to be discharged in the vicinity of dredging operations

We believe this approach is reasonable. Using the environmental bucket to backfill in shallow water should result in very little water being left in the barge, because the mechanics of removing the backfill material from the barge will be similar to that used to dredge it from the bottom. The longer the dredge material remains in the barge before backfilling, the more it will return to its original density on the bottom. If the shallow water barges are not hopper barges, they will leave the work site on completion of the shallow water work and not be an issue for the pipeline crossing. If they are hopper barges, they will be subsequently used in the deep water work. Under these conditions, the water should be allowed to remain in the barge during the first filling and then dumped with the first backfill. This will slightly reduce the available volume of the barge for the first fill only. Thereafter, the operations will not be affected by the remaining water. Should it be necessary to dispose of supernatant water without resorting to dumping, we suggest that TSS, SS and turbidity measurements of the water be made to demonstrate that it is equal to or better than the observed conditions during dredging, before commencing dewatering of a barge.